UNITED STATES PATENT APPLICATION

for

DIRECTIONAL PAD HAVING INTEGRATED ACOUSTIC SYSTEM AND LIGHTING SYSTEM

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BACKGROUND OF THE INVENTION

PRIORITY

[0001] This application claims priority from the provisional application entitled DATA PROCESSING DEVICE HAVING MULTIPLE MODES AND MULTIPLE ASSOCIATED DISPLAY/ KEYBOARD CONFIGURATION, Serial No. 60/507,257, Filed September 29, 2003.

Field of the Invention

[0002] This invention relates generally to the field of data processing input devices. More particularly, the invention relates to an input device having an integrated speaker and lighting system.

Description of the Related Art

[0003] Portable data processing devices such as Personal Digital Assistants ("PDAs") and programmable wireless telephones are becoming more powerful every day, providing users with a wide range of applications previously only available on personal computers. At the same time, due to advances in silicon processing technology and battery technology, these devices may be manufactured using smaller and smaller form factors. Accordingly, users no longer need to sacrifice processing power for portability when selecting a personal data processing device.

[0004] Although processing devices with small form factors tend to be more portable, users may find it increasingly difficult to interact with them. For example, entering data may be difficult due to the absence of a full-sized keyboard and reading information may be difficult due to a small, potentially dim Liquid Crystal Display ("LCD"). Moreover, given the fact that telephony and data processing functions may require different types of input/output elements (e.g., directional pads, telephony speakers, light emitting diodes, . . . etc), the real estate on the external surface of data processing devices is at a premium. Accordingly, to the extent possible, it is desirable to integrate multiple input/output functions into a single input/output device.

SUMMARY

[0005] An apparatus for use in a data processing device is described in which an audio system and a light system is embedded within a cursor control device such as a directional pad. In one embodiment, the apparatus comprises a cursor control device for performing one or more defined cursor control functions; an audio system embedded within the cursor control device, the audio system configured to generate audio signals responsive to audio signals received and/or generated by the data processing device; and a light source embedded within the cursor control device, the light sources configured to generate light from the cursor control device responsive to control signals generated by the data processing device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] A better understanding of the present invention can be obtained from the following detailed description in conjunction with the following drawings, in which:

[0007] **FIGS. 1-2a** and **2b** illustrate exemplary data processing devices on which embodiments of the invention may be employed.

[0008] **FIG. 3** illustrates a perspective view of the exemplary data processing device in which one embodiment of the invention is illustrated.

[0009] **FIG. 4** illustrates one embodiment of an integrated directional pad, speaker and light emitting diode.

[0010] **FIG. 5** illustrates elements associated with directional pad operation according to one embodiment of the invention.

[0011] **FIG. 6** illustrates elements associated with an integrated acoustic system employed in one embodiment of the invention.

[0012] **FIG. 7** illustrates elements associated with an integrated lighting system employed in one embodiment of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0013] In the following description, for the purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be apparent, however, to one skilled in the art that the present invention may be practiced without some of these specific details. In other instances, well-known structures and devices are shown in block diagram form to avoid obscuring the underlying principles of the present invention.

[0014] An integrated directional pad, acoustic system and lighting system for a data processing device is described below. As will be apparent from this description, the integrated device is particularly beneficial when employed on a multi-purpose data processing device such as a personal digital assistant ("PDA") or other mobile computing device having integrated wireless telephony capabilities (e.g., a combination PDA and cell phone). It should be noted, however, that the underlying principles of the invention are not limited to a wireless PDA/telephony configuration.

AN EXEMPLARY DATA PROCESSING DEVICE

[0015] An exemplary data processing device on which embodiments of the invention may be employed is illustrated in **Figures 1, 2a** and **2b**. The exemplary data processing device 100 comprises a display 110 with a viewable display area 105 for displaying various types of text and graphics. The illustrated data processing device 100 includes a plurality of different modes of operation which may be associated with a respective plurality of display and/or device

orientations. In the first mode of operation, the display is viewed in a first position, illustrated generally in **Figure 1** in which it covers an alphanumeric keyboard 205 illustrated in **Figures 2a-b**. In this first position, the display is located flush within the boundary defined by the non-display portions of the data processing device 100.

[0016] By contrast, when the display is in the position illustrated in **Figures 2a-b**, the alphanumeric keyboard 205 is exposed and usable for data entry. In the embodiment illustrated in **Figure 2a**, the display 110 slides from the first position to the second position in a direction substantially parallel to a plane defined by the front surface of the data processing device 100, as indicated by motion arrows 225. The sliding motion may be accomplished via pins or posts (not shown) on the backside of the display 110 that are engaged with tracks 210, 215 located on the face of the data processing device 100 to the left and right of the alphanumeric keyboard 205, respectively.

[0017] Various additional/alternative mechanisms may be used to guide the display from the first position to the second position (and vice versa). For example, in the embodiment illustrated in **Figure 2b**, the display rotates around a pivot point 250 from the first position to the second position, as indicated by motion arrow 251. Of course, the underlying principles of the invention are not limited to any particular mechanism for adjusting the display 110.

[0018] In one embodiment, the data processing device 100 includes a first set of control elements 115 positioned to the right of the display 110 and a second set of control elements 120 positioned to the left of the display (i.e., to the "right" and "left" while the display in the orientation illustrated in **Figure 1**). In one embodiment, the first set of control elements 115 includes a control wheel 130 positioned between two control buttons, 126 and 135, as illustrated. As in prior embodiments of the invention, the control wheel 130 may be used to move a cursor control device, highlight bar or other selection graphic on the display to select menu items, program icons and/or other graphical or textual display elements. In one embodiment, the control wheel 130 is made of clear plastic with an light emitting diode ("LED") or other light source embedded therein.

[0019] In one embodiment, the first control button 126, located above the control wheel 130, is a "page up" button for generating "page up" control functions. For example, when a word processing document, Web page, email message or other type of document is displayed in the foreground of the display 110, selection of the first control button 126 will jump upward through the displayed data/images by a full display screen's worth of data/images. When navigating through menus, selection of the first control button 126 may cause a selection element to jump multiple menu items or other graphical elements. Various different/additional "page up" functions may be trigged via the first control button 126 while still complying with the underlying principles of the invention. The second control button 135, located below the control wheel 130, is a "page down" button for generating "page down" control functions (e.g., which operate in

the same manner as the "page up" control functions but in the opposite direction).

[0020] In one embodiment, a series of additional control elements 150, 155, 160, and 20 are configured on the data processing device 100 to provide various additional preprogrammed and/or user-specified control functions. For example, a control element 150 may be a designated "home" key for jumping to the data processing device's main menu, or performing application-specific functions typically associated with a "home" key (e.g., moving a cursor to the beginning of a line in a word processing document). Control element 155 may be a dedicated a "menu" key which generates a context-specific menu when selected (e.g., a different menu may be generated based on which application is currently running). Control keys 160 and 165 may be designated "jump" keys, allowing the user to easily jump to (i.e., execute) a designated application program. The control elements 150, 155, 160 and 165 may be programmed for various alternate and/or additional functions while still complying with the underlying principles of the invention.

[0021] In one embodiment, the second set of control elements includes a directional pad 145 having an integrated speaker 146 and/or light source, as described in detail below with respect to **Figures 3-7**. The directional pad 145 may be used to move a cursor or other selection graphic in any direction on the display to enable selection of menu items, program icons and other graphical or textual display elements. The directional pad 145 may be made of frosted

translucent plastic and may be white in color, although other materials and colors may be used. An LED contained in on embodiment of the directional pad may be a tri-color LED that generates a variety of colors to alert the user when an incoming message has been received. In "telephony mode" (described below), the speaker 146 contained in the directional pad 145 enables the user to hear the party on the other end of a call. In addition, a microphone 140 is configured at the end of the data processing device 100 opposite the speaker 146 so that the data processing device 100 may be held like a mobile phone while in telephony mode (i.e., when the speaker placed next to the user's ear, the microphone is located in the proximity of the user's mouth).

[0022] In one embodiment, when in "telephony mode" the functions performed by the various control elements 115, 120 and/or keys on the keypad 205 change to designated telephony functions. For example, in the telephony mode of operation, the control button 126 above the scroll wheel may function as a "call" button with which the user may initiate a telephone call once the number to be called has been entered. The control button 125 below the scroll wheel 130 may function as a "hang up" button, with which the user may conclude a telephone call. Similarly, referring to **Figures 2a-b**, to simplify numeric data entry when in telephony mode, a designated set of alphanumeric keys 220 from the keyboard 205 may change to a numeric keypad (e.g., the 'y' key may change to a '1' key, the 'u' key may change to a '2' key, . . . etc).

[0023] In addition, the glyphs on the control elements 115, 120 and/or keys on the keypad 205 may change to reflect the change in operation in the same or a similar manner as described in the embodiments above. For example, light emitted by LEDs embedded within the control buttons 125 and 126 on either side of the scroll wheel 130 may be modified to reflect the change in operation in telephony mode. In one embodiment, for example, the "call" and "hang up" glyphs are highlighted on the control buttons 125 and 126, in contrast to "page up" and "page down" glyphs, respectively.

ONE EMBODIMENT OF AN INTEGRATED DIRECTIONAL PAD, ACOUSTIC SYSTEM AND LIGHT SYSTEM

[0024] One embodiment of the invention 300, illustrated in **Figures 3-7**, comprises an integrated directional pad, acoustic system and light system. **Figure 3** provides a high level view of the angled cross-section used to view the pertinent aspects of this embodiment of the invention (i.e., having both a diagonal component and a non-diagonal component). **Figure 3** also provides a high level view of the manner in which the directional pad, acoustic system and light system may be embedded within a data processing device 100.

[0025] The directional pad 145 of this embodiment is comprised of a button shell 401 having an external surface 400 (i.e., exposed to the end user) and an inner surface 411. In one embodiment, a protective mesh layer 402 is attached to inner surface 411 of the button shell 401 with adhesive. The protective mesh layer 402 separates the internal surface of the button shell 401 from an audio receiver unit 404, and provides protection for the audio receiver unit 404.

[0026] An audio receiver boot 403 is affixed to the internal surface of the button shell 401, as illustrated. An audio receiver unit 404 is inserted into the rubber boot 403, which secures the audio receiver unit 404 in place. In one embodiment, to manufacture the directional pad/audio receiver combination, the audio receiver unit 404 is first inserted into the rubber boot 403 and then the rubber boot 403/receiver 404 combination is affixed to the button shell 401. However, various manufacturing procedures may be employed while complying with the underlying principles of the invention.

[0027] In one embodiment, a flex circuit 405 is positioned onto mating details on an actuator platform 406, which is then snapped into the button shell 401. A micro-switch 407, gimble socket 408, acoustic chamber 409, and light emitting diode ("LED") 410 are all assembled to a printed circuit board ("PCB") 412. A center sphere 502 on the bottom of the actuator platform 406 is placed into the gimble socket 408. The flex circuit 405 is then inserted into a connector and is also assembled to the PCB 412. The top housing 415 drops down over the assembly and captures the button shell 401, as illustrated.

Directional Pad Operation

[0028] Referring to **Figure 5**, In one embodiment, because the center sphere 502 on the bottom of the actuator platform 406, the dish 503 of the gimble socket 408, the semi-spherical surface 505 of portions of the button shell 401, and the mating surfaces 501 of the button shell 401 all share the same center, the directional pad 145 tilts up to a specified number of degrees (e.g., 5 degrees) in

any direction. In one embodiment, the tilting forces actuator bumps 504 placed at each of four equidistant quadrants on the bottom of the actuator platform 406 to activate each of four corresponding micro-switches 407, also placed at the quadrants around the gimble socket 408. This mechanism allows an end user to guide the cursor on the screen in any of four directions, corresponding to the four actuator bumps 504. It should be noted, however, that the underlying principles of the invention are not limited to a four-way directional pad or, for that matter, to any particular mechanism for inputting control signals to the data processing device.

Acoustic System Operation

[0029] Referring now to **Figure 6**, the audible output from the audio receiver 404 fills the chamber 603 above it, passes through the protective mesh 402 and out through two holes, 601 and 602, in the button shell 401. In one embodiment, to optimize the audio output, a system of audio ports and chambers is provided on the under side of the audio receiver 404. Specifically, a large chamber of air 509 is configured behind the audio receiver 404 thereby allowing the speaker within the audio receiver 404 to generate sound efficiently. A plurality of port holes 605 couple the back of the audio receiver 404 to the air chamber 509. In the particular embodiment illustrated in **Figure 6**, four port holes 605 are configured within the diagonals of the actuator platform (e.g., at or near each of the four corners). Of course, the underlying principles of the invention are not limited to any particular number of port holes 605.

[0030] In one embodiment, the port holes 605 are sealed to holes 607 in the PCB 412 by elastomer cones 606 which may be over-molded onto the actuator platform 406. The flexibility of the elastomer cones 606 allow the actuator platform 406 to tilt freely to perform the cursor control functionality described herein while maintaining the acoustic integrity of the audio port system. In this embodiment, the elastomer cones 606 act as springs, pushing the button shell 401 up into the top housing 415, thereby preventing rattling of the button shell 401 and maintaining the button level when no force is being applied to the top surface 400 of the button shell 401.

[0031] Air enters and exits the large air chamber 509 via a series of exit holes 608 along one edge of the chamber. In the particular embodiment shown in **Figure 6**, the holes are directed into the inner volume of the data processing device 100. The air transmitted through to the inner volume may then exit to the outside of the data processing device 100 through two ports 604 configured between the button shell 401 and the top housing 415.

Light Pipe Operation

[0032] In one embodiment, one or more LEDs 703 are positioned underneath the button shell to illuminate the button shell under certain conditions (e.g., to announce an incoming call, email message, . . . etc). In one embodiment, the button shell 401 is molded in a clear plastic and the upper surfaces 701 are covered with a thin coat of paint (e.g., to match the color scheme of the data processing device 100). As such, light shining from the LEDs 703 passes

through the polished walls 702 of the button shell 401, reflects within the button shell 401 and thereby illuminates the entire button shell. Because the light is reflected within the button shell 401, in one embodiment, only one or two LEDs are needed (e.g., positioned at adjacent corners of the button shell). However, the particular number of LEDs used is not pertinent to the underlying principles of the invention.

[0033] Throughout the foregoing description, for the purposes of explanation, numerous specific details were set forth in order to provide a thorough understanding of the invention. It will be apparent, however, to one skilled in the art that the invention may be practiced without some of these specific details. For example, while the embodiments described above employ LEDs as a light source, various different types of light sources may be employed while still complying with the underlying principles of the invention. In addition, although the embodiments of the invention described above use a four-way directional pad, the underlying principles of the invention may be implemented in cursor control devices having various capabilities (e.g., eight way directional pads, 360-degree multi-directional devices such as track pointers, . . . etc).

[0034] In other instances, well-known structures and techniques have not been shown in detail to avoid obscuring the underlying principles of the present invention. For example, certain details of the audio receiver 404 illustrated in **Figures 3-7** have not been described in detail to avoid obscuring the pertinent

aspects of the invention. Accordingly, the scope and spirit of the invention should be judged in terms of the claims which follow.